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Evaluating Radiative Feedback Mechanisms in Coastal West Africa Using Regional Climate Models

Authors : Akinnubi Rufus Temidayo

Abstract : Coastal West Africa is highly sensitive to climate variability, driven by complex ocean-atmosphere interactions that shape temperature, precipitation, and extreme weather. Radiative feedback mechanisms—such as water vapor feedback, cloud-radiation interactions, and surface albedo—play a critical role in modulating these patterns. Yet, limited research addresses these feedbacks in climate models specific to West Africa's coastal zones, creating challenges for accurate climate projections and adaptive planning. This study aims to evaluate the influence of radiative feedbacks on the coastal climate of West Africa by quantifying the effects of water vapor, cloud cover, and sea surface temperature (SST) on the region's radiative balance. The study uses a regional climate model (RCM) to simulate feedbacks over a 20-year period (2005-2025) with high-resolution data from CORDEX and satellite observations. Key mechanisms investigated include (1) Water Vapor Feedback—the amplifying effect of humidity on warming, (2) Cloud-Radiation Interactions—the impact of cloud cover on radiation balance, especially during the West African Monsoon, and (3) Surface Albedo and Land-Use Changes—effects of urbanization and vegetation on the radiation budget. Preliminary results indicate that radiative feedbacks strongly influence seasonal climate variability in coastal West Africa. Water vapor feedback amplifies dry-season warming, cloud-radiation interactions moderate surface temperatures during monsoon seasons, and SST variations in the Atlantic affect the frequency and intensity of extreme rainfall events. The findings suggest that incorporating these feedbacks into climate planning can strengthen resilience to climate impacts in West African coastal communities. Further research should refine regional models to capture anthropogenic influences like greenhouse gas emissions, guiding sustainable urban and resource planning to mitigate climate risks.

Keywords : west africa, radiative, climate, resilence, anthropogenic
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